STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL | 97-027

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD) **7 February 1997**

3. DOCUMENT TITLE
Tag Registry

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

Add Radiant Tin Tagged Record Exension to the NITFS suite

(See Attachment)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

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Radiant Tin Tagged Record Extension Registration Request

The purpose of this document is to provide information to the National Imagery Transmission Format Standard (NITFS) Technical Board (NTB) regarding the various capabilities of the Radiant Tin application. It is the intention of the Johns Hopkins University Applied Physics Laboratory (JHU/APL) and the Navy Tactical Exploitation of National Capability (TENCAP) Office to apply for a registered tag within the NITFS to facilitate integration of Radiant Tin with a variety of NITF compliant host systems. Radiant Tin will be utilized within these systems to perform a variety of "tactical imagery analysis" related functions to include enhanced capabilities to perform automatic change detection, target recognition, pseudo map generation and automatic alignment of uncontrolled imagery with controlled imagery. The use of a registered tag will allow the community to get acquainted with the capabilities of Radiant Tin and identify requirements for standardization groups to insert these capabilities into the mainstream of NITF and Basic Image Interchange Format (BIIF) evolution.

I. Radiant Tin Overview

Radiant Tin is an effort sponsored by the Navy Tactical Exploitation of National Capability (TENCAP) Office focusing on the development and fielding of various software based imagery exploitation "tools". The goal of the project is to improve the usefulness and availability of national imagery, organic imagery and graphic products in support of tactical operations while accommodating the needs of lower-echelon units that rely on low-data-rate communications and simple processors for the distribution and processing of operational information.

II. Radiant Tin Licensing and Distribution

The Radiant Tin Software is licensed for use by the U.S. Government and can be used for U.S. Government specific applications without special approval. Commercial vendors may receive the Radiant Tin source code from DOD sponsors provided a non disclosure agreement has been signed and the code is not used for commercial applications or internal R&D. Licenses for research or commercial purposes are available from Texas Tech University. The software is currently distributed by The Johns Hopkins University / Applied Physics Laboratory (JHU/APL) to selected organizations on behalf of Navy TENCAP.

III. Radiant Tin Capability

Through a process called "decomposition," Radiant Tin software (running on existing tactical data processors where possible) transforms the pixels of a digital image into polynomial equations describing straight lines, curves, and shades of gray

in the image. This transformation results in the creation of a symbol file which encapsulates the parameters of the equations. Note the symbol file can only be derived from an original pixel based image. Although intended to be included with the original pixel based image, the symbol file may be transmitted among tactical units as a binary data file using existing communications systems and standard protocols to accommodate bandwidth constraints. Once received, the symbol file can be processed into a course representation of the original image.

Since the symbolic data set is several orders of magnitude smaller than the original image, it does not add significant storage penalty to add the data to an NITF file which contains the original image pixels (uncompressed or compressed using existing NITF defined compression algorithms). The data contained in the symbol file provides the means to perform a variety of image based functions including the following:

Automatic change detection. Radiant Tin algorithms are designed to automatically detect the differences between two images of the same scene. Because the process relies on a mathematical rather than a pixel-by-pixel comparison, it is not necessary to rectify and mensurate the two images prior to comparing them. In addition, sensor models are not required.

Object recognition/ Feature extraction. Radiant Tin analysis tools can automatically detect the presence of objects of tactical interest (e.g., tanks, artillery, aircraft, etc.) in an image. In a prototype system, aircraft and man made features were correctly identified. As part of a image content retrieval system, objects of interest are coded via symbolic data, and then used in a database to search for similar objects.

Pseudo map generation. Radiant Tin algorithms have been used to generate pseudo maps from aerial photos, and National Technical Means (NTM) products. In addition, since these image derived products are already formatted as symbolic data, they can be automatically aligned and / or mosaiced with new images collected by other means (e.g. theater UAV).

Automatic Alignment. Radiant Tin symbolically converted images can be automatically aligned as a first step in sensor fusing uncontrolled field collected images with precise geolocated image data (e.g. Controlled Image Base (CIB). By including the symbolic data set as corollary information to a geolocated image, raw uncontrolled images may be automatically aligned in the field, and geolocation information may be derived for tactical operations.

Symbolic Enhancement. Symbolic processing of imagery has been used to perform image enhancement. As part of its data compression algorithm, edge data is merged with the image to provide tactically valuable information merged with highly compressed data products. This type of enhancement may also be used to add-in tactically significant features to poorly collected or highly compressed imagery.

Imagery Compression. Since the symbolic file generated from the decomposition process is smaller that the original, pixel based image, compression is a natural by-product. In the early period of the Radiant Tin project, there was a significant demand for passing imagery products over bandwidth limited tactical communications links. To meet the demand, the symbolic file was further encoded to reduce its size even further. All applications and field use were conducted in non-NITF compliant systems without support of the TACO-2 protocol. Since the symbolic decomposition process tends to retain tactically useful features, however, analytical exploitation of the symbolic data can provide useful value-added information for the tactical users. This concept is similar to that in which the NITF uses CGM data as a more efficient representation of older bit mapped symbols.

IV. Description of Radiant Tin Tag

Registered Tagged Record Extension Definition

-----Radiant Tin Registered Tag-----	
Field	**Value**
RETAG	RADTIN
REL	1 to 99988, possibly > 99988 *
RTTITLE	80 byte Character array (included in the length estimate for REL
REDATA	Bit oriented Symbolic Representation, last byte is zero filled

* The registered tagged record extension may appear in the Registered Extensions Data Extension Segment if sufficient space is not in the User Defined Image Data field, UDID.

V. Rationale and Justification for Tag

Each of the capabilities afforded by Radiant Tin require the presence of the symbolic information file. The symbolic file is created by the Radiant Tin application and is unique to that process. Currently, there is no tag definition within the NITFS which could be used to identify the Radiant Tin symbolic file. Hence, this request is being made to acquire such a tag registration so that the analysis oriented capabilities of Radiant Tin described earlier can be hosted on targeted NITF compliant systems and made available to tactical users.

In addition, many of the targeted systems identified for Radiant Tin integration have a native format which is NITF (e.g. JMCIS). By putting Radiant Tin into the NITFS, it will be possible to add the Radiant Tin capability without extensive software changes and the generated products will be accessible to a larger and more diverse user base.

At the end of the two year registered tag lifetime, several options will be considered to establish the Radiant Tin capability as an integral part of the NITFS. These options are identified and described in Section VII.

VI. Concept of Operations for Radiant Tin Symbol Tag

The Radiant Tin image processing tools afford the tactical user a new means to manipulate and tactically exploit imagery using both NTM products from sources like the 5D server and theater level imagery when available.

The automated image analysis tools would reside on board surface ships (non CV), submarines and shore based command sites such as the Enhanced Command Operations Center (ECOC) associated with a Marine Air Ground Task Force (MAGTF) ashore or embarked on a large deck amphibious vessel.

Conceptually, a tactical user could call for an image from the 5D server and request a Radiant Tin symbol tag with it. The symbol file, derived from the original (uncompressed) image, is critical to the use of Radiant Tin analysis tools at the receive site. Once the tag file has been developed, no further image information is needed and the original image can be compressed by standard NITF defined means in preparation for transmission.

Once received at the tactical site (LHA, ECOC, etc.), the user would transform local imagery or imagery of the same scene or AOR (UAV, DTARPS, digital maps, etc.) from other sources using the Radiant Tin tools. Using the source and local symbol files, any of the listed analysis operations could be performed. The result would be an enhanced tactical image derived product with value added information gained from the use of additional image based information. This enhanced product could then be passed along communication links to lower echelon tactical forces for display and use.

The tag data (symbol file) is transmitted along with the original image data in all cases except across extremely bandwidth limited communications links in which the symbol file is better than no data. In this case, the tag may be sent by itself or as part of the NITF file structure with an icon representing the original image data. This would allow the non-tag aware software to present something to the user in case the file somehow escapes out of the normal distribution scheme.

VII. Radiant Tin Current and Planned Usage

Radiant Tin has been utilized for over 4 years to directly address various tactical needs and requirements in numerous demonstrations, exercises and scenarios. Radiant Tin provided a value added capability and served as an enabling technology in the following tactical field activities: Secure Tactical Data Network (STDN)-4, Joint Warrior Interoperability Demonstration (JWID)94, Marine Expeditionary Unit (MEU) Deployment Support, Special Project Night Vector, RIMPAC-94, SUBEX-95, TANDEM THRUST-95, and NAVCENT Meteorological Support.

Radiant Tin is currently being utilized at various military and government facilities including NAVSPECWARGRU 1 & 2, EUCOM, 7th Fleet, 3rd Fleet, JDISS PMO, 1 MEF, NAVCENT/CENTCOM, and NRaD. Radiant Tin has also been integrated into the Battle Group Information Exchange System (BGIXS) II by Command Submarine Atlantic (CONSUBLANT) as a replacement for CLUSTER KNAVE.

Current tasking involves the integration of Radiant Tin with the Joint Maritime Command Information System (JMCIS), Java Image and Video Exploitation (JIVE) and JDISS NT. In order to address the need for NITF compliance associated with each of these systems, it is necessary for Radiant Tin to obtain a registered tag in the NITFS. In addition, a formal registration of a Radiant Tin Tag will provide the opportunity for both current and future users of Radiant Tin to become part of the NITFS community.

VIII. Migration from Registered Tag to Mainstream Use within NITFS

Radiant Tin is a R&D project that will prove the feasibility of performing automated image analysis in a tactical environment (in theater operations). At the end of the two year evaluation period, the Register Tag will expire. At that time three options will be evaluated:

- Implement a Controlled Tag with appropriate documentation so that symbolic conversion can be provided to all NITFS systems.

- After an evaluation of JPEG 2000, transition symbolic processing to a compatible method included within the standard. The Radiant Tin image analysis algorithms would be recast in terms of data derived from the JPEG 2000 compressed products.

- Recommend development of a new image transformation standard if neither the JPEG 2000 nor the current NITF standards support the Radiant Tin image analysis tools. This recommendation would be forwarded with the requirements derived from field demonstrations and users' comments on the utility and value of the new standard.